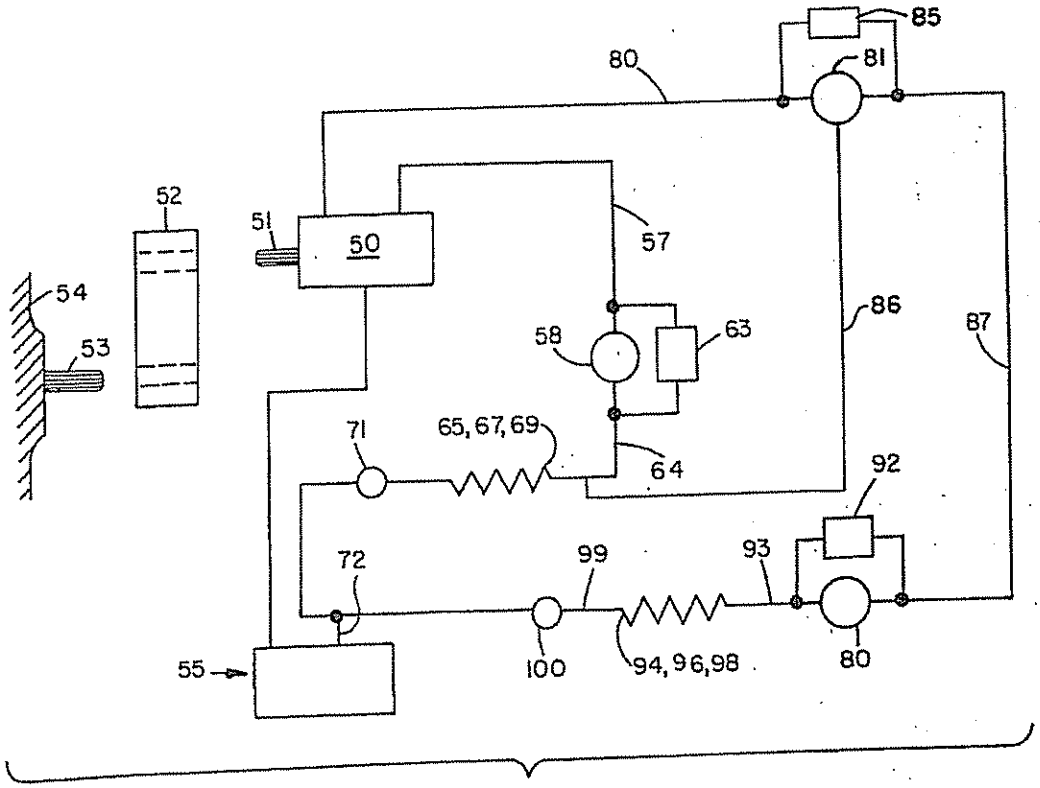
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FIG. 4

HYDRAULICALLY DRIVEN MOWER

BACKGROUND OF THE INVENTION

This invention relates generally to hydraulically driven mowing machines or mowers and more particularly to large roadside mowers of the type propelled or pulled by a tractor or other vehicle.

The use of hydraulic motors to power mowing machines or other implements is known in the art. Examples of mowing machines which have hydraulically driven cutting means are found in the following U.S. Patents:

U.S. Pat. No. 2,166,940—C. M. Conradson
U.S. Pat. No. 2,603,052—C. L. Pelham
U.S. Pat. No. 2,840,974—T. J. Dunn Et Al
U.S. Pat. No. 2,888,088—A. Claas Et Al
U.S. Pat. No. 3,087,296—J. T. Cowles
U.S. Pat. No. 3,135,079—T. J. Dunn
U.S. Pat. No. 3,221,482—R. E. Cowling
U.S. Pat. No. 3,263,036—R. W. Bailey Et Al
U.S. Pat. No. 3,319,407—B. L. Jordan Et Al
U.S. Pat. No. 3,404,518—H. D. Kasper
U.S. Pat. No. 3,462,925—J. K. Lanier
U.S. Pat. No. 3,498,036—R. E. Cowling Et Al
U.S. Pat. No. 3,511,033—R. K. Strasel
U.S. Pat. No. 3,526,083—R. O. Barry Et Al
U.S. Pat. No. 3,563,012—R. K. Strasel
U.S. Pat. No. 3,727,712—M. J. Colloton
U.S. Pat. No. 3,788,418—Clancey Et Al
U.S. Pat. No. 3,832,835—Hall Et Al
U.S. Pat. No. 3,854,271—E. J. Aldred
U.S. Pat. No. 3,949,539—J. O. Cartner
U.S. Pat. No. 3,973,379—F. A. Ecker Et Al.

In particular, in U.S. Pat. Nos. 2,603,052 and 2,840,974 there are shown hydraulically powered sickle mowing machines. In U.S. Pat. No. 3,511,033, there is shown a rotary reel-type mowing machine which is hydraulically-powered. There are many examples of hydraulically-powered rotary mowing machines such as that shown in U.S. Pat. No. 3,135,079.

The use of hydraulic power has particular utility for multiple unit mowing machines as well as for side mounted and boom mounted mowing machines when the drive-train is not readily suited for a mechanical drive. Mowers such as shown in U.S. Pat. No. 3,404,518 and the enclosed brochure depicting the "TK-15" fifteen foot rotary mower of assignee Terrain King Corporation of Seguin, Texas generally require folding wing sections for transport. U.S. Pat. No. 3,404,518 attempts to solve the transporting problem of multiple gang mowers by having only the outer housing sections foldably mounted. In the case of the "TK-15" mower by Terrain King Corporation, the entire outer wing section folds for transport purposes. In the case of typical shaft driven sections, provision must be made for the folding.

It is desirable to eliminate the mechanical drive train of mowing machines since they can become quite complicated when multiple mowing units are provided. However, in the case of hydraulical motors, the efficiency of the motors and the heat generated in the hydraulic drive fluid may be a problem. Conventional hydraulic piston pumps and motors may be used on mowers because of their high efficiency. Gear-type pumps and motors are advantageous since they can be more easily controlled in the case of dividing flow for multiple motors.

A problem with large motors of the type shown in U.S. Pat. No. 3,135,079 is the heat generated in hydraulic drive fluid. Under heavy load conditions the hydraulic drive fluid may reach such a high operating temperatures that it can be damaged. Accordingly, some way must be provided to cool the hydraulic fluid to dissipate the heat created by the high pressure pumps and motors utilized. Increasing the amount of hydraulic fluid may help cooling. However, this increases the weight of the machine and adds to the cost of operating.

It is known in the prior art that radiators may be utilized to provide cooling to hydraulic fluid. Examples of such cooling devices are found in U.S. Pat. Nos. 2,166,940, 3,727,712 and 3,788,418. These devices use conventional radiators or heat exchangers which in the case of the latter two patents is positioned so that the cooling fan of an engine provides air flow to dissipate the heat. In the case of cooling fins, cuttings may cover or attach to the fins which may reduce their efficiency. It has also been known in the prior art to utilize structural components for conducting and storing hydraulic fluid. An example of this is shown in U.S. Pat. No. 2,888,088 and it is also known to utilize structural members such as in tractor front end fork-lifts and in construction machines and the like to store hydraulic fluid and to act as conduits. The use of frame members for flowing hydraulic fluid has also been known in mowing machines. However, so far as known the only cooling provided by flowing hydraulic fluid through the frame members occurs from radiation or free convection to the surrounding air.

Applicant first discovered that it could obtain adequate and efficient cooling for a hydraulically-driven mowing machine by circulating the return flow of hydraulic fluid through sealed structural members of the deck which members constitute rectangular tubing which forms the skeleton of the mower deck. The mower deck acts as a huge heat sink capable of dissipating the heat generated by the hydraulic system. The tubing and the deck have a continuous, forced flow of air circulating over their lower heat radiating surfaces which is generated by the up-draft-type blades of the mower. This creates a very efficient heat exchange using forced air convection to dissipate the heat with the up-draft blades also acting to suck up vegetation into the cutting plane. The high efficiency minimizes the required hydraulic fluid for cooling which reduces weight.

It was initially thought to be undesirable to utilize the structural members of the mower deck since this requires a special deck for a hydraulic-type mower. For purposes of economy and manufacturing it would be desirable to provide a mower deck which could be used for either a mechanical or a hydraulic-type mowing machine. It was thought that a heat exchanger which was not in the path of air flow of the cutting blades could be utilized. However, such a unit does not have the efficiency of utilizing the air flow from the blades and it is not believed to be as desirable. Not withstanding the increased cost to manufacture the mower deck whose structural members are suitable for flowing low pressure hydraulic fluid, such a device possesses numerous unexpected advantages over other types of cooling means for the hydraulic fluid.

When multiple hydraulic motors have been used it was previously believed that this could be accom-

plished with a fluid divider. However it has been found that problems arise in designing a fluid divider which will maintain a substantially constant flow of fluid to each motor when very high fluid pressures are involved.

One method used for multiple motors as found in U.S. Pat. No. 3,135,079 which connects the motors in series, and uses a pressure relief valve which bypasses fluid to the sump when the pressure setting is exceeded. In operation if the first motor of such a series overloads then it will dump the hydraulic fluid to the sump which will lessen the amount of fluid supplied to the following motors in the series. This will result in slowing of the following motors which would not be generally desired. Accordingly, it is another object of the invention to provide a hydraulic drive system for multiple hydraulic motors which will maintain a substantially constant flow of fluid to all of the motors when one or more motors experiences excessive loading. Thus all motors operate independent of one another.

SUMMARY OF THE INVENTION

The invention comprises a hydraulically driven mower for connecting with a prime mover. The mower has a rotary-type cutting means for mowing and which rotary-type cutting means creates air flow during cutting. Heat transfer means are provided on the mower frame and positioned so that air flow created by the rotary cutting means removes heat from hydraulic fluid therein to provide cooling of the hydraulic fluid during mowing. The heat transfer means includes structural members of the mower deck or frame so that the housing of the mower can act as a heat sink and provide cooling. The hydraulic drive system includes at least two hydraulic motors connected in series with pressure relief means connected in parallel with each motor to bypass hydraulic fluid in case of overloading.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective partial view showing a tri-section rotary mower embodying the invention.

FIG. 2 is a partial top view of a tri-section rotary hydraulically driven mower embodying the invention.

FIG. 3 is a schematic cross-section view depicting the air flow of the cutting blades against the board deck to provide cooling of the hydraulic fluid in the structural members.

FIG. 4 is a schematic view of the hydraulic system of the invention.

BRIEF DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, there is shown a tri-sectional mowing apparatus M which is adapted to be attached to a prime mover such as a tractor (not shown). The mowing apparatus M concludes a center section C and left and right wing sections L and R, respectively. The wing sections are connected to the center section through hinges 10, 11, 12, 13, 14 and 15. This allows the wing sections to be folded up for highway transport. A lifting frame 16 is secured with the center section and includes hydraulic cylinders 17 and 18 which are secured to brackets 19 and 20 which are secured to the left and right wing sections, respectively. Hydraulic fluid is supplied to the cylinders 17 and 18 through hydraulic supply lines 21 and 22, respectively. A mechanical winch 23 may also be provided to lift the left and right wing sections through a cable 24 which may be removably secured to each of the wing sections such as by bracket 25.

Adjustable support wheel units 26, 27, 28 and 29 are provided at the rear of the center, right and left wing sections for rolling support thereof. A front hitching means 30 is provided for connecting the mowing apparatus to a prime mover such as a tractor. The hitching means is pivotally mounted to the center section through brackets 31 and 32 so that it may be pivoted upwardly and downwardly by hydraulic lifting cylinders 33 and 34 which are supplied fluid through hydraulic line 35. Link members 36 and 37 interconnect the hitching means 30 and the support wheel units 27 and 28 so that activation of the cylinders 33 and 34 to their extended position will raise the central unit of the mower which likewise raises and lowers the left and right wing sections. The center and left and right wing sections are maintained substantially level during this lifting operation since the hitching means also raises the front portion of the mowing apparatus as the support wheel units 27 and 28 raise the rear portion. Safety chain curtains 38 are provided at the front of the mowing apparatus and safety chain curtains (not shown) which are known in the art are also provided at the rear of the mowing apparatus to prevent the mowing blades from throwing debris and materials from under the mower.

The left wing section L includes a generally flat deck member 39 with a solid side portion 40. The right wing section R includes a similar flat deck member 41 having a solid side portion 42. The center section C includes a flat deck member 43.

The mowing machine heretofor described is of generally conventional construction of the type which has previously been powered by rotary shafts and gear boxes. It is at this point that the similarity in a mechanically driven unit and the hydraulically powered unit of the invention diverge. As will be explained more fully hereinafter, the mower of the invention is powered by three hydraulic motors and includes a oil reservoir mounted on the mower which is connected to a auxiliary pump for supplying hydraulic fluid under pressure to the hydraulic motors.

The hydraulic system of the mowing apparatus M can best be visualized from FIGS. 2 and 4. The system includes a hydraulic gear-type pump 50 having two sections. The pump includes an input shaft 51 which is connected to a 4:1 gear increaser 52. The gear increaser 52 is connected to a PTO output shaft 53 which is driven by the power source 54 which typically may be a tractor.

A typical RPM for the PTO output shaft is 540 RPM's so that the gear increaser will drive the pump at 2160 RPM's. It is understood that the gear increaser might be changed accordingly in the case of a 1000 RPM PTO output shaft. The pump 50 might also be changed to any pump which would meet the requirements of fluid flow and pressure and which may eliminate the need for the speed change.

A sump or oil storage container 55 is mounted on the center section C for holding a supply of hydraulic fluid. Fluid exits the sump 55 through pump input hose 56 which is connected to the input of the pump 50. It is understood that the hose 56 is of the flexible rubber type to allow relative movement between a prime mover and the mowing apparatus M during turning.

A first flexible output hose 57 is connected to one section of the pump 50 and is connected to the hydrau-

lic motor 58 which powers the updraft blade means 59 for the center section. Blades means 59 includes a central mounting hub 60 and two updraft blades 61 and 62 to cut vegetation. The updraft blades 61 and 62 act to suck up vegetation into the cutting plain of the blades during operation and circulate air over the cooling members. Blade means 59 are of conventional construction of the type which may be used on any rotary mowing machine.

The hydraulic motor 58 includes a relief valve means 63 which is set to bypass fluid around the motor 58 and through the exhaust line 64. The relief valve 63 may be typically set to bypass fluid when the fluid pressure exceeds 2500 pounds per square inch. This might occur should the blade 61 or 62 strike an object and stop rotation of the motor 58 which would greatly increase the pressure. This eliminates the need for typical slip clutches which are conventionally used in mechanically driven drive systems.

Fluid exiting the motor 58 travels through the exhaust line or hose 64 to the rear end of hollow, fluid-conducting frame member 65 which forms a conduit extending along the flat deck member 41. The hydraulic fluid travels substantially the length of the frame member 65 where it exits into flexible hose 66 so that it passes through hollow, fluid-conducting frame member 67 which forms another conduit. The hollow frame member 67 is mounted on the solid deck member 43 of the central section. The fluid travels rearwardly through the hollow frame member 67 where it exits through a flexible hose 68 and enters hollow, fluid-conducting frame member 69 which is also connected to the flat deck member 43 of the central section. Hollow frame member 69 forms a conduit so said fluids travel forwardly therethrough until it exits flexible hose 70 which is connected to filter means 71. Fluid then travels through conduit 72 into sump 55 for recirculation through the system. As will be apparent from FIG. 3, during operation of the hydraulic pump 50 which provides fluid flow through the central hydraulic motor 58 the hydraulic fluid is flowing through the hollow, fluid-conducting frame members 65, 67 and 69 which in turn have air flow over the lower portion thereof created by the mowing blades. The hollow, fluid-conducting frame members 65, 67 and 69 are sized to provide sufficient cooling through their heat transfer surfaces. As shown the flat deck is in direct contact with one side of the conduit. Debris may collect and cover the frame members during operation which could effect heat transfer. However, the deck member lower surface is contacted by the air flow from the blades which provide heat transfer from the fluid in the frame members which are rigidly secured to the deck such by welding. The heat from the hydraulic fluid is conducted from the frame members through the deck which acts like a fin to provide some cooling.

The left and right wing sections are driven by the second stage of the pump 50 which includes flexible output line 80 which supplies hydraulic fluid to the right hydraulic motor 81. The right hydraulic motor 81 is connected to a central mounting hub 82 which in turn is connected to updraft blades 83 and 84 of the same general type as updraft blades 61 and 62. Hydraulic motor 81 includes a relief valve 85 which bypasses fluid from the motor 81 to flexible line 87 when the pressure exceeds 1750 pounds per square inch. Flexible line 81 is connected to the next motor so it does not lose performance when motor 81 slows or stops. This would occur such as when blades 83 or 84 strike an object stopping or slowing rotation of the hydraulic motor. An external drain line 86 as shown in FIG. 2 is provided to drain any enternal leakage past the motor gear pressure plates to the hollow frame member 65. The drain line 86 is required since the outlet of motor 81 does not go directly to the sump. Hydraulic fluid exits the outlet of motor 81 through flexible line 87 which directs it to the left hydraulic motor 88.

The left hydraulic motor 88 is also connected to a central mounting hub 89 which in turn is connected to updraft blades 90 and 91. The central mounting hubs of all three sections as well as the blades of all three sections are of substantially the same construction which is of a conventional variety. Accordingly, no further description is provided thereof.

The hydraulic motor 88 includes a relief valve 92 as shown schematically in FIG. 4. The relief valve 92 is set to bypass fluid from the mower when the pressure exceeds 1750 pounds per square inch. As with the other relief valves, the purpose of relief valve 92 is to bypass fluid such as when blade 90 or 91 strikes an object causing a sudden increase in pressure in the hydraulic system. Fluid is exhausted from the motor 88 through line 93 which directs the hydraulic fluid through the rear end of hollow, fluid-conducting frame member 94 which forms a conduit extending the length of the deck 39. As with the other hollow frame members, member 94 is sealingly secured to the deck 39 which comes is in contact with the air flow from the blades. The hydraulic fluid flows through the hollow frame member 94 and exits through flexible hose 95 which directs the hydraulic fluid into hollow, fluid-conducting frame member 96 which is mounted on the central flat deck member 43 and extends the length thereof. As with the other hollow frame members, hollow frame member 96 forms a conduit for flowing the hydraulic fluid passing therethrough. The hydraulic fluid exits the hollow frame member 96 through flexible line 97 which directs it into hollow, fluid-conducting frame member 98 which is also in contact with the central flat deck portion 43 and extends longitudinally the length thereof. The fluid exits the hollow frame member 98 through flexible line 99 which directs the hydraulic fluid into filter 100 which is connected to conduit 72 which directs the hydraulic fluid back into the sump 55.

The hollow frame members 65, 67, 69, 94, 96 and 98 are rigidly secured in contact with the central and left and right sections of the mowing apparatus. They are of course sealed at their ends and are sufficient strength for the frame as well as for conducting the low pressure hydraulic fluid. As previously described their contact with the flat deck members of the three sections transfer heat thereto so that the flow of air as shown in FIG. 3 created by the rotation of the updraft blades helps transfer heat from the hydraulic fluid flowing in the frame members. The amount of heat transfer as determined by their effective heat transfer surface areas is predetermined to provide cooling to the hydraulic fluid in the system to protect the hydraulic fluid from overheating. The integral heat exchanger deck arrangement is preferred since it utilizes the air flow from the updraft blades which increases the cooling of the hydraulic fluid. Other configurations of fluid-conducting members could be utilized which would provide sufficient heat transfer from the hydraulic fluid to prevent overheating which could damage the hydraulic fluid. The frame members are shown on the upper surface of the

deck members which provides a smooth deck member lower surface. Other possible arrangements of fluid-conducting members would require sufficient heat transfer capabilities as determined by the needs of the system. It is contemplated that the air flow from the blades would be used with whatever arrangement to provide the necessary cooling to protect the hydraulic fluid from overheating.

While there has been shown and described a preferred embodiment of a hydraulically driven mower in accordance with the invention, it will be appreciated that many changes and modifications may be made therein without, however, departing from the essential spirit of the invention within the scope and the claims.

I claim:

1. A hydraulically driven rotary mower comprising:

a deck member;

at least two hydraulic motors;

rotary cutting blade means operatively connected to said hydraulic motors and positioned adjacent said deck member wherein air flow generated by rotation of said blade means impinges upon said deck member;

hydraulic fluid conduit means for circulating hydraulic fluid operatively connecting said hydraulic motors with a source of hydraulic pressure wherein said hydraulic fluid conduit means is in contact with said deck member to provide sufficient heat transfer from the hydraulic fluid to the deck member whereby the contacting relation of said hydraulic fluid conduit means and said deck member serves as a heat transfer means for transferring sufficient heat from hydraulic fluid circulating in said hydraulic fluid conduit means to said deck member which deck member serves as heat dissipation means by utilizing the air flow from the blade means for cooling to prevent overheating and damage to the hydraulic fluid.

2. The mower as set forth in claim 1, wherein:

the hydraulic fluid conduit means includes at least one structural member forming a portion of a mower frame.

3. The mower as set forth in claim 1, wherein:

the hydraulic fluid conduit means includes a plurality of elongated structural members forming a portion of a mower frame.

4. The mower as set forth in claim 1, wherein:

the hydraulic fluid conduit means includes a plurality of elongated conduits mounted on a mower deck member.

5. The mower as set forth in claim 1, wherein:

the mower includes a central section and two side sections, each having a hydraulic motor operatively connected with rotary cutting means for mowing.

6. The mower as set forth in claim 1, wherein;

the rotary cutting blade means includes a blade means rotating about a generally vertical shaft.

7. A hydraulically driven tri-section rotary mower, comprising:

a central section with right and left wing folding sections connected thereto;

at least one hydraulic motor operatively connected with each section and having a rotary cutting blade means connected with the hydraulic motor for mowing;

each section comprising a generally flat deck member the lower surface of which is contacted by the air flow from the rotary cutting blades; and

a plurality of longitudinally extending frame members which provide conduit means for flowing hydraulic fluid therethrough for driving the hydraulic motors and which contact the flat deck members to dissipate heat through the deck members to provide sufficient heat transfer thereto so that air flow created by the rotary cutting blade means will provide sufficient heat transfer from the hydraulic fluid in the conduit means through the deck members to provide cooling of the hydraulic fluid during operation of the rotary cutting blade means to prevent overheating of and damage to the hydraulic fluid.

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United States Patent [19]

Cracraft

[11] **Patent Number: 4,901,507**

[45] **Date of Patent: Feb. 20, 1990**

[54] **PIVOTED DECK LAWNMOWER**

[76] Inventor: Larry D. Cracraft, Rt. #3 Box 165, Maryville, Mo. 64468

[21] Appl. No.: 279,510

[22] Filed: Dec. 5, 1988

[51] Int. Cl.[4] A01D 34/66; A01D 34/86; A01D 75/30

[52] U.S. Cl. 56/6; 56/15.9; 56/235

[58] Field of Search 56/6, 15.6, 16.2, 14.9, 56/208, 209, 235, 255, 15.9

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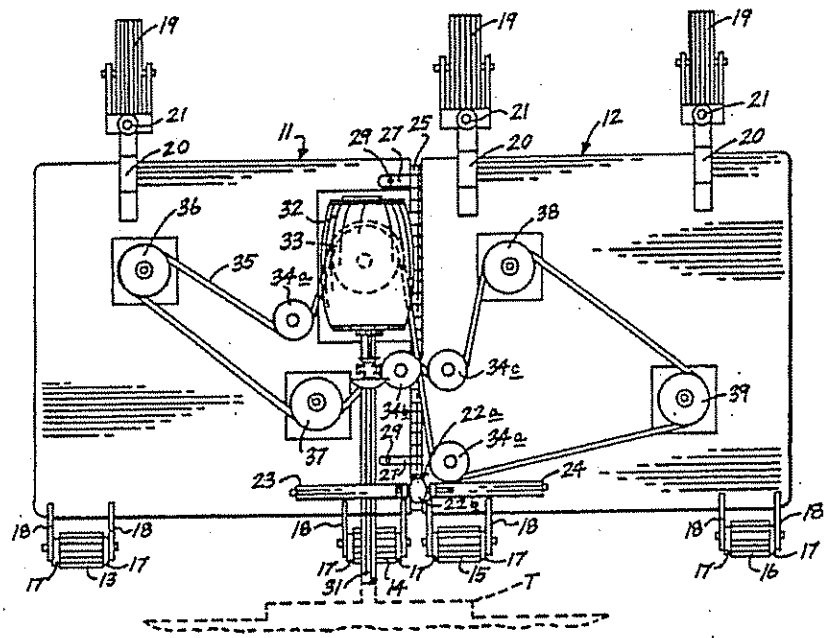
3,404,518	10/1968	Kasper	56/6 X
3,418,790	12/1968	Whitfield et al.	56/6
3,465,505	9/1969	Krinke	56/320.1
3,473,302	10/1969	Caldwell	56/6
3,654,750	4/1972	Lely	56/16.2
4,266,395	5/1981	Basham	56/209
4,442,658	4/1984	Cartner	56/6 X
4,497,160	2/1985	Mullet et al.	56/13.6 X
4,621,696	9/1986	Brouwer	56/68.2 X

Primary Examiner—Stephen J. Novosad
Attorney, Agent, or Firm—Leon Gilden

[57] ABSTRACT

A lawnmower of a type utilized in conjunction with a self-propelled vehicle, such as tractor, includes a plurality of decks, each housing a plurality of rotating cutting blades wherein the plurality of decks are pivotally secured and adjustable relative to one another to accommodate various ground contours.

9 Claims, 4 Drawing Sheets



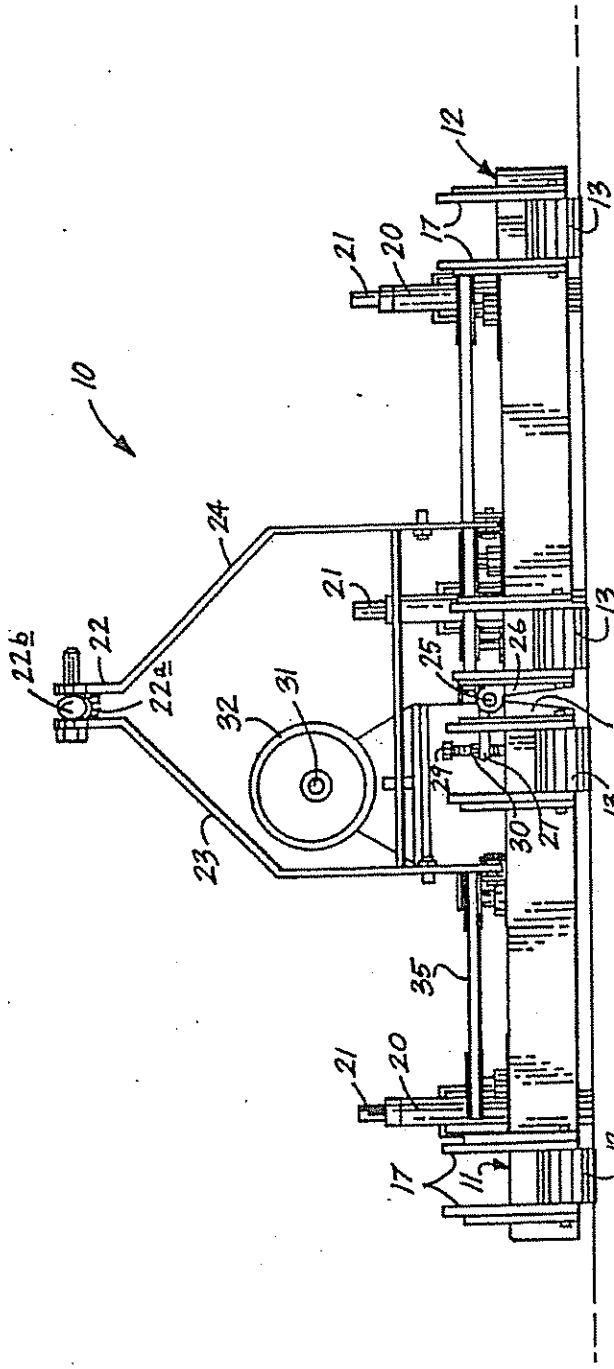


FIG. 1

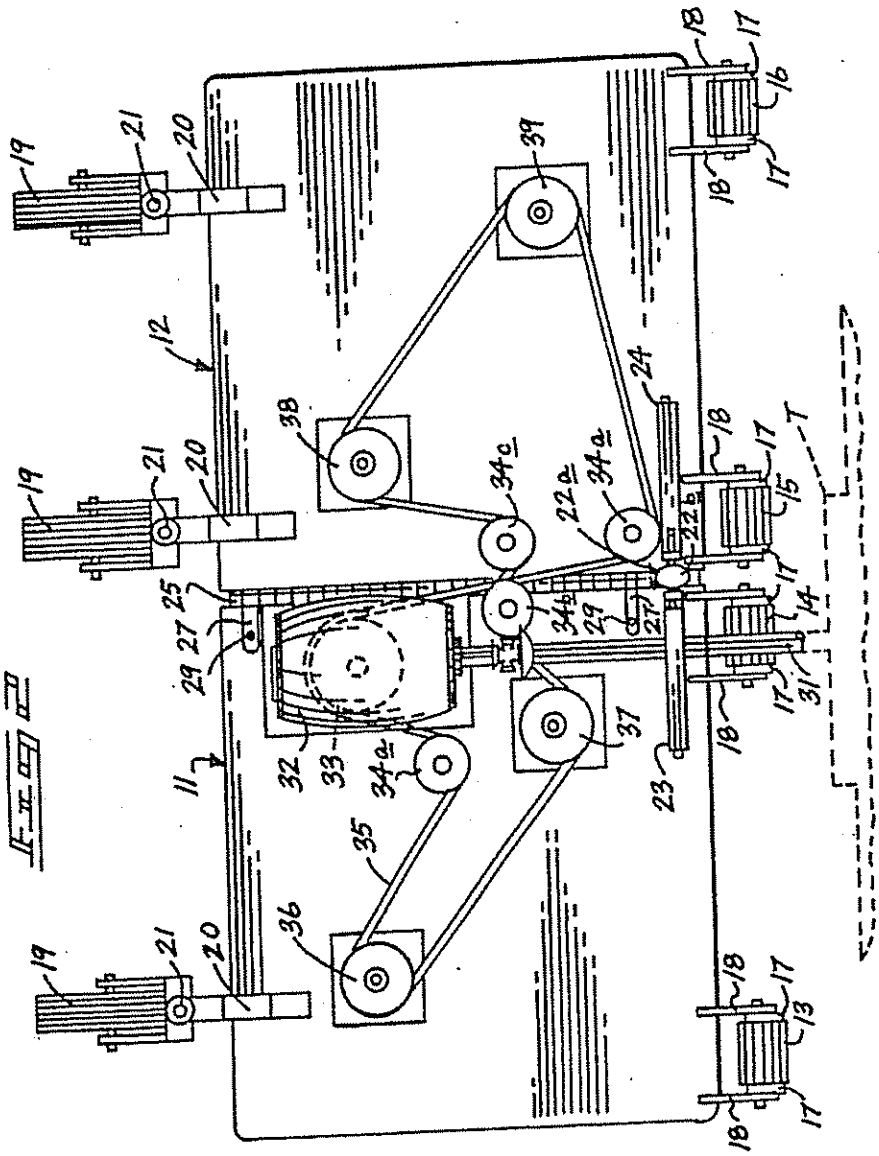

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FIG. 2

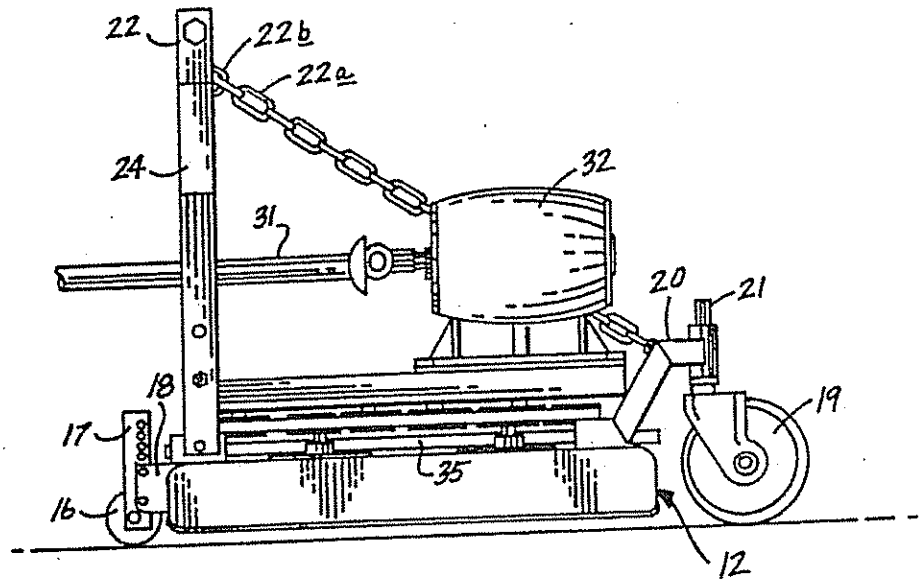

Fig. 3

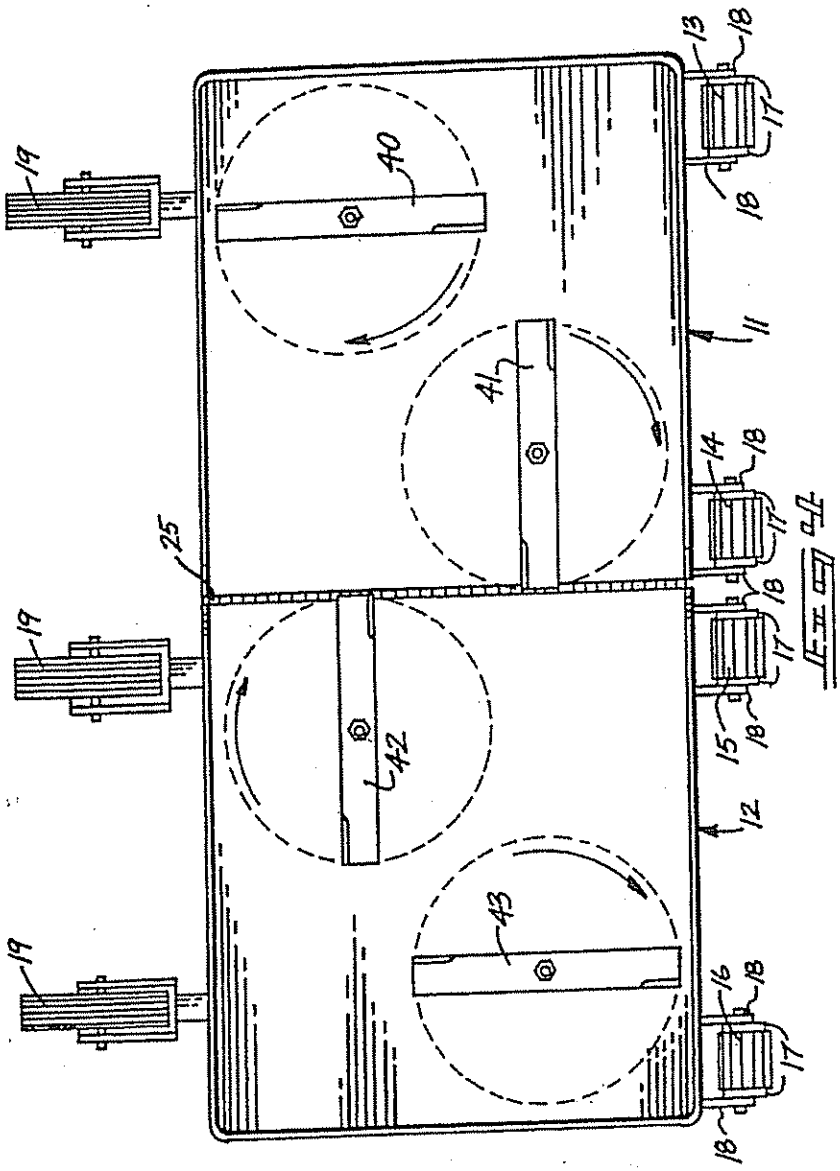

Fig. 3

PIVOTED DECK LAWNMOWER

BACKGROUND OF THE INVENTION

1. Field of the Invention

The field of invention relates to lawnmowers, and more particularly pertains to a new and improved pivoted deck lawnmower wherein the same includes a plurality of housings pivoted together to accommodate various ground contours while cutting a large swathe of lawn.

2. Description of the Prior Art

The use of lawnmowers of the "estate type" are well known in the prior art. Typically, these lawnmowers are utilized to cut large tracts of grass and accordingly are of a size commensurate for the task. Lawnmowers of the past have frequently been of a construction to include a single housing with a plurality of cutting blades therein wherein a traverse of such large ground does not readily accommodate ground contours that may fall within the perimeter of a large lawnmower deck. For example, U.S. Pat. No. 3,654,750 to Van Der Lely illustrates a longitudinally aligned mowing machine utilizing forward skids and rearwardly mounted wheels with a plurality of decks pivotally associated with one another wherein each deck includes a single axially mounted rotating blade organization, as opposed to the instant invention utilizing a plurality of rotating cutting members associated with each deck, a pivoting hinge associated between a plurality of decks, and a drive shaft for the decks generally centrally mounted of the decks and parallel to the axial pivoting of the decks, as opposed to the Van Der Lely patent.

U.S. Pat. No. 3,465,505 to Krinke sets forth a lawnmower housing wherein the wheel support structure is pivotally mounted to the housing to enable pivoting of the housing relative to a ground surface contour.

U.S. Pat. No. 3,375,645 to Miller wherein the rotary blade and a guard associated therearound is tiltably mounted about a centrally longitudinal extending axis to maintain the guard generally parallel to a ground surface to be mowed.

U.S. Pat. No. 4,621,696 to Bruwer sets forth a harvesting machine wherein a sod cutting head is pivotally connected to a frame associated with a front pivot shaft formed with an axis aligned along the path of travel and a plurality of rear pivots positioned rearwardly of the cutting head wherein the rear pivots are mounted such that they are formed to have the same effect as a horizontal rear pivot shaft located and aligned with the front pivot shaft.

U.S. Pat. No. 4,266,395 to Basham sets forth a harvesting machine that is tiltably mounted relative to the throat or intake of the harvesting machine about a lower longitudinally extending pivot located proximate the forward section of the throat such that various ground contours may be accommodated between opposed lateral ends of the header of the combine or harvesting device.

As such, it may be appreciated that there is a continuing need for a new and improved pivoted deck lawnmower which accommodates variations in ground contour and may be centrally disposed rearwardly of a self-propelled vehicle and as such, the present invention substantially fulfills that need.

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages inherent in the known types of pivoted deck lawnmowers now present in the prior art, the present invention provides a pivoted deck lawnmower wherein the same includes a plurality of pivotally mounted lawnmower decks disposed along either side of a pivot axis wherein said pivot axis is aligned generally parallel with a drive shaft associated with a forwardly mounted self-propelled vehicle to enable enhanced control and guidance of the apparatus. As such, the general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new and improved pivoted deck lawnmowers which has all the advantages of the prior art pivoted deck lawnmower and none of the disadvantages.

To attain this, the present invention includes a plurality of lawnmower deck housings wherein each housing includes a plurality of axes each supporting a cutting means. The plural decks are pivotally mounted wherein the degree of pivotment between the decks is controlled by means of a plurality of limiting devices to avoid binding of the drive mechanism of the invention. Further, the axis of pivotment is aligned generally parallel to the drive shaft axis of the instant invention to enhance control of the apparatus in use.

My invention resides not in any one of these features per se, but rather in the particular combination of all of them herein disclosed and claimed and it is distinguished from the prior art in this particular combination of all of its structures for the functions specified.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood, and in order that the present contribution to the art may be better appreciated. There are, of course, additional features of the invention that will be described hereinafter and which will form the subject matter of the claims appended hereto. Those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

Further, the purpose of the foregoing abstract is to enable the U.S. Patent and Trademark Office and the public generally, and especially the scientists, engineers and practitioners in the art who are not familiar with patent or legal terms or phraseology, to determine quickly from a cursory inspection the nature and essence of the technical disclosure of the application. The abstract is neither intended to define the invention of the application, which is measured by the claims, nor is it intended to be limiting as to the scope of the invention in any way.

It is therefore an object of the present invention to provide a new and improved pivoted deck lawnmower which has all the advantages of the prior art pivoted deck lawnmowers and none of the disadvantages.

It is another object of the present invention to provide a new and improved pivoted deck lawnmower which may be easily and efficiently manufactured and marketed.

It is a further object of the present invention to provide a new and improved pivoted deck lawnmower which is of a durable and reliable construction.

An even further object of the present invention is to provide a new and improved pivoted deck lawnmower which is susceptible of a low cost of manufacture with regard to both materials and labor, and which accordingly is then susceptible of low prices of sale to the consuming public, thereby making such pivoted deck lawnmowers economically available to the buying public.

Still yet another object of the present invention is to provide a new and improved pivoted deck lawnmower which provides in the apparatuses and methods of the prior art some of the advantages thereof, while simultaneously overcoming some of the disadvantages normally associated therewith.

Still another object of the present invention is to provide a new and improved pivoted deck lawnmower centrally located relative to a self-propelled vehicle formed with a plurality of decks pivotally associated relative to one another and disposed to either side of the vehicle to provide enhanced control of the apparatus.

These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the claims annexed to and forming a part of this disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be had to the accompanying drawings and descriptive matter in which there is illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and objects other than those set forth above will become apparent when consideration is given to the following detailed description thereof. Such description makes reference to the annexed drawings wherein:

FIG. 1 is a frontal orthographic view of the instant invention.

FIG. 2 is a top orthographic view of the instant invention.

FIG. 3 is a side orthographic view taken in elevation of the instant invention.

FIG. 4 is a bottom orthographic view of the instant invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the drawings, and in particular to FIGS. 1 to 4 thereof, a new and improved pivoted deck lawnmower embodying the principles and concepts of the present invention and generally designated by the reference numeral 10 will be described.

More specifically, it will be noted that the pivoted deck lawnmower 10 of the instant invention essentially comprises a first housing deck 11 hingedly and pivotally mounted to a second housing deck 12. The first housing deck mounts a first and second forward support wheel 13 and 14 respectively, while the second housing deck 12 supports a third and fourth forward wheel 15 and 16 respectively. The support wheels are essentially of elongate cylindrical configuration for enhanced support of surface contact during use wherein the support wheels are axially aligned with one another when the first and second housing decks 11 and 12 are aligned with each other. The support wheels are mounted to forwardly extending housing brackets 18 by forward wheel brackets 17 each formed with through-extending apertures to adjust the cutting height of the apparatus by vertical positioning of the support wheels, as may be illustrated in FIG. 3 for example. The apparatus includes a trio of rear wheels 19 that are pivotally mounted about parallel pivoting axles 21 oriented generally orthogonally to the axles of the support wheels 17 wherein the pivoting axles 21 are mounted to rear braces 20 extending upwardly and rearwardly of the respective first and second housing decks 11 and 12, as illustrated in FIGS. 1 through 4.

A yoke 22 is mounted centrally of the elongate pivot hinge 25 coextensive with housings 11 and 12. A first leg 23 of the yoke member 22 is pivotally mounted to housing 11 with a second leg 24 pivotally mounted to housing 12.

With reference to the pivot hinge 25, a pivot axle support housing 26 surroundingly encompasses the elongated pivot axle of the hinge 25 and is secured to housing 12 with a second pivot axle support housing 26*a* surroundingly encompassing the elongate pivot axle and secured to a housing 11 wherein the first and second pivot axle support housings 26 and 26*a* are secured to vertical side walls of the housings 11 and 12 in confronting relationship, as illustrated in FIG. 1. A leg 27 is integrally formed to the first pivot axle support housing 26 and wherein a plurality of the legs 27 are utilized, as illustrated in FIG. 2 for example, in an overlying parallel relationship to a top surface of the first housing 11. The legs 27 are formed with adjustment screws 29 threadedly therethrough with associated lock nuts 30. As illustrated in FIG. 1, it may be appreciated that the lower terminal surface of the adjustment screws 29 are spaced somewhat from the top surface of housing 11 to limit pivoting of housing 11 relative to housing 12 whereupon the limiting of the relative motion between the housings will avoid excessive of angularity between the various drive pulleys of the various housings and any binding that may occur between the housings during use.

A drive shaft 31 powered by a self-propelled vehicle "T", typically a tractor, is mechanically associated with a gear multiplication housing 32 by means of a "U" joint. The gear multiplication housing 32 employs gearing of a two to one ratio to enhance the speed of the associated cutting blades of the apparatus. A central drive pulley 33 is in underlying relationship to the housing 32 with a continuous belt 35 operatively positioned about the idler pulleys 34*a*, 34*b*, 34*c*, and 34*d* with a pair of idler pulleys associated with each housing, as illustrated in FIG. 2 for example. Housing 11 supports a first and second cutter pulley 36 and 37 with housing 12 supporting a third and fourth cutter pulley 38 and 39. The pulleys are fixedly secured to centrally oriented axles. Reference to FIG. 4 illustrates the respective first, second, third, and fourth rearward blades 40, 41, 42, and 43 associated with respective pulleys 36 through 39. It may further be noted that a chain in FIG. 3 illustrates the use of maintaining the yoke 22 in position prior to use with a hook 22*b* fixedly secured to yoke 22. When in use, the chain 22*a* is merely disassociated from hook 22*b* whereupon yoke 22 is coupled to the tractor "T" for associating the apparatus with the tractor. It should be noted that in use of the instant invention, the first and second housings 11 and 12 are medially aligned behind the pulling vehicle "T" with the drive shaft 31 disposed generally parallel to the pivot hinge 25.

The use and operation of the instant invention therefore should be apparent from the above disclosure and accordingly no further discussion relative to the manner of use and operation of the instant invention will be provided.

With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as being new and desired to be protected by LETTERS PATENT of the United States is as follows:

1. A mowing apparatus for connection to a self-propelled vehicle comprising,

a first housing defining a first cavity, and a second housing defining a second cavity, and

cutting means rotatably mounted within said first and second cavities for mowing of grass wherein said cutting means include at least one rotatable blade within each of said first and second cavities fixedly and rotatably secured to a shaft, and

each shaft projects upwardly through said first and second housings terminating in a pulley, and

an elongate drive shaft directed forwardly of said first and second housings for attachment to a power source at a forward end of said drive shaft, and

a gear housing secured to said first housing wherein said drive shaft is secured to said gear housing at its other end, and

said gear housing operably associated with each pulley of said cutting means for imparting rotation to said pulleys, and

elongate hinge means securing said first and second housing together, and

wherein said drive shaft is orientated parallel to said hinge, and

a yoke member projecting upwardly of a forward surface of said first and second housings positioned medially of said hinge means, and

a plurality of first wheels secured to rear surfaces of said first housing and a plurality of second wheels secured to rearward surfaces of said first and second housings wherein said first and second wheels rotatably support said first and second housings for traverse over a surface to be mowed and,

wherein said yoke member includes a connector for connection to a self-propelled vehicle, and wherein said yoke further includes a plurality of legs wherein a first leg is secured to said first housing and a second leg secured to said second housing positioning said yoke medially relative to said elongate hinge.

2. A mowing apparatus as set forth in claim 1 wherein said elongate hinge is coextensively secured to adjacent surfaces of said first and second housings, and

said hinge further includes at least one leg secured to said hinge and projecting and overlying said first housing parallel to an upper surface of said housing and formed with a threaded through-extending aperture, and

an adjustment screw threadedly mounted through said through-extending aperture oriented orthogonally relative to said upper surface of said first housing for creating an abutment surface with said first housing to limit pivoting of said first housing relative to said second housing.

3. A mowing apparatus as set forth in claim 2 wherein said second wheels are adjustably mounted to said first and second housing including a plurality of bracket members provided with through extending apertures to orient said second wheels relative to said first and second housings.

4. A mowing apparatus as set forth in claim 3 wherein said second wheels include generally cylindrical rotatable members whose axes are aligned relative to each rotatable member.

5. A mowing apparatus as set forth in claim 4 wherein said first wheels are secured to pivot shafts wherein said pivot shafts are oriented generally orthogonally to upper surfaces of said first and second housings and wherein said pivot shafts of each of said first wheels are aligned.

6. A mowing apparatus as set forth in claim 5 wherein said gear housing includes gear reducing gear means effecting a two to one gear ratio advantage and wherein said gear housing is secured to a central pulley wherein an endless belt is secured about said central pulley and said pulleys are associated with said cutting means for rotation of said cutting means upon rotation of said central pulley.

7. A mowing apparatus as set forth in claim 6 wherein said drive shaft is aligned parallel to said elongate hinge means.

8. A mowing apparatus as set forth in claim 7 wherein said yoke includes a hook releasably securing a chain for selectively securing said yoke in a vertical orientation relative said first and second housings when not in use.

9. A mowing apparatus as set forth in claim 8 wherein said drive shaft is operably associated with said gear housing at its other end by a universal joint.

* * * * *

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United States Patent [19]

Scott et al.

[11] Patent Number: 5,137,100

[45] Date of Patent: Aug. 11, 1992

[54] **HYDROSTATIC TRANSMISSIONS**

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[73] Assignee: Ultra Hydraulics Limited, Cheltenham, England

[21] Appl. No.: 642,218

[22] Filed: Jan. 16, 1991

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 600,823, Oct. 22, 1990.

[51] Int. Cl.[5] B62D 11/00

[52] U.S. Cl. 180/6.48; 56/DIG. 11; 60/428; 180/19.1; 180/19.3; 180/53.4; 180/242; 180/305; 180/307; 180/308

[58] Field of Search ..... 180/6.48, 19.1, 19.2, 180/19.3, 242, 305, 306, 307, 308, 53.1, 53.4; 60/384, 421, 428; 56/10.6, 10.8, 10.9, 11.4, 11.9, 13.6, DIG. 11

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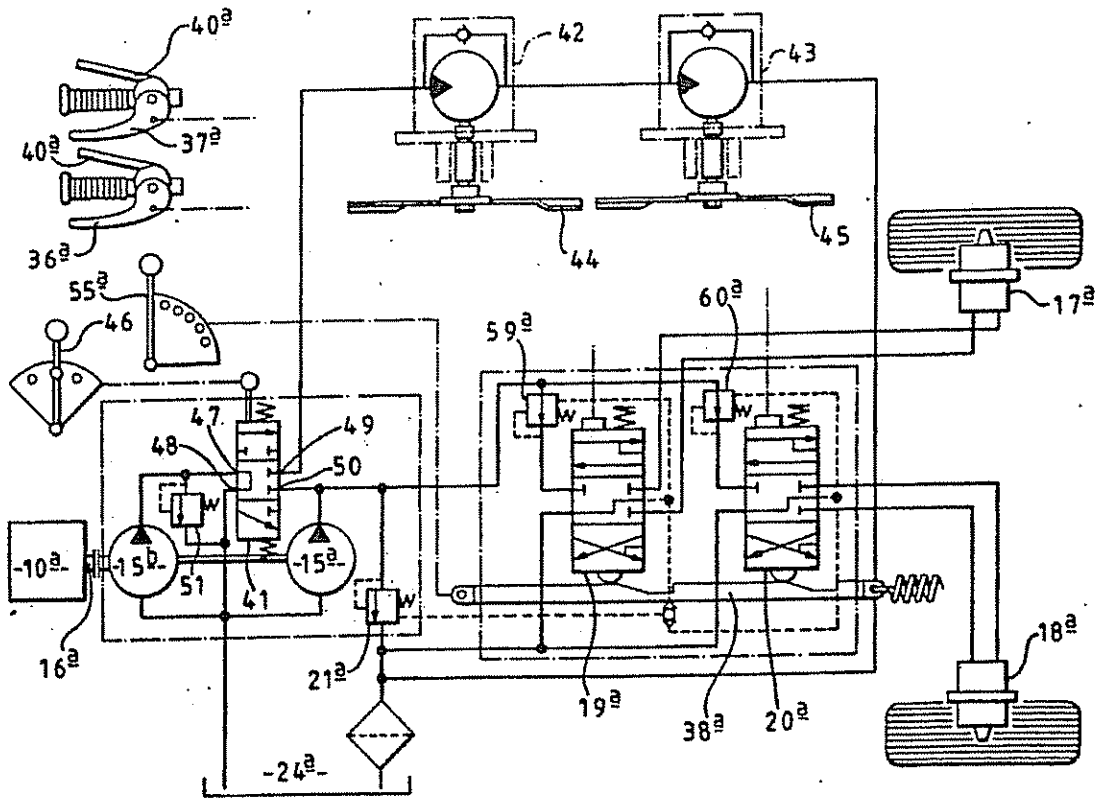
Primary Examiner—Mitchell J. Hill
Attorney, Agent, or Firm—Young & Thompson

[57] **ABSTRACT**

A hydrostatic transmission for a vehicle, such as a commercial walk-behind mower, comprises a fixed displacement pump, first and second reversible hydraulic motors for driving first and second ground engageable wheels, respectively, of the vehicle, and first and second spool valves for controlling hydraulic fluid flow from the fixed displacement hydraulic pump to the first and second hydraulic motors, respectively. The transmission may have a further fixed displacement hydraulic pump arranged in tandem with the first mentioned pump, a fluid pressure operated device and a third spool valve movable between a first position in which hydraulic fluid from the further pump is supplied to the pressure operated device and a second position in which hydraulic fluid from the further pump is supplied to the first and second spool valves to supplement hydraulic fluid from the first mentioned hydraulic pump.

7 Claims, 2 Drawing Sheets



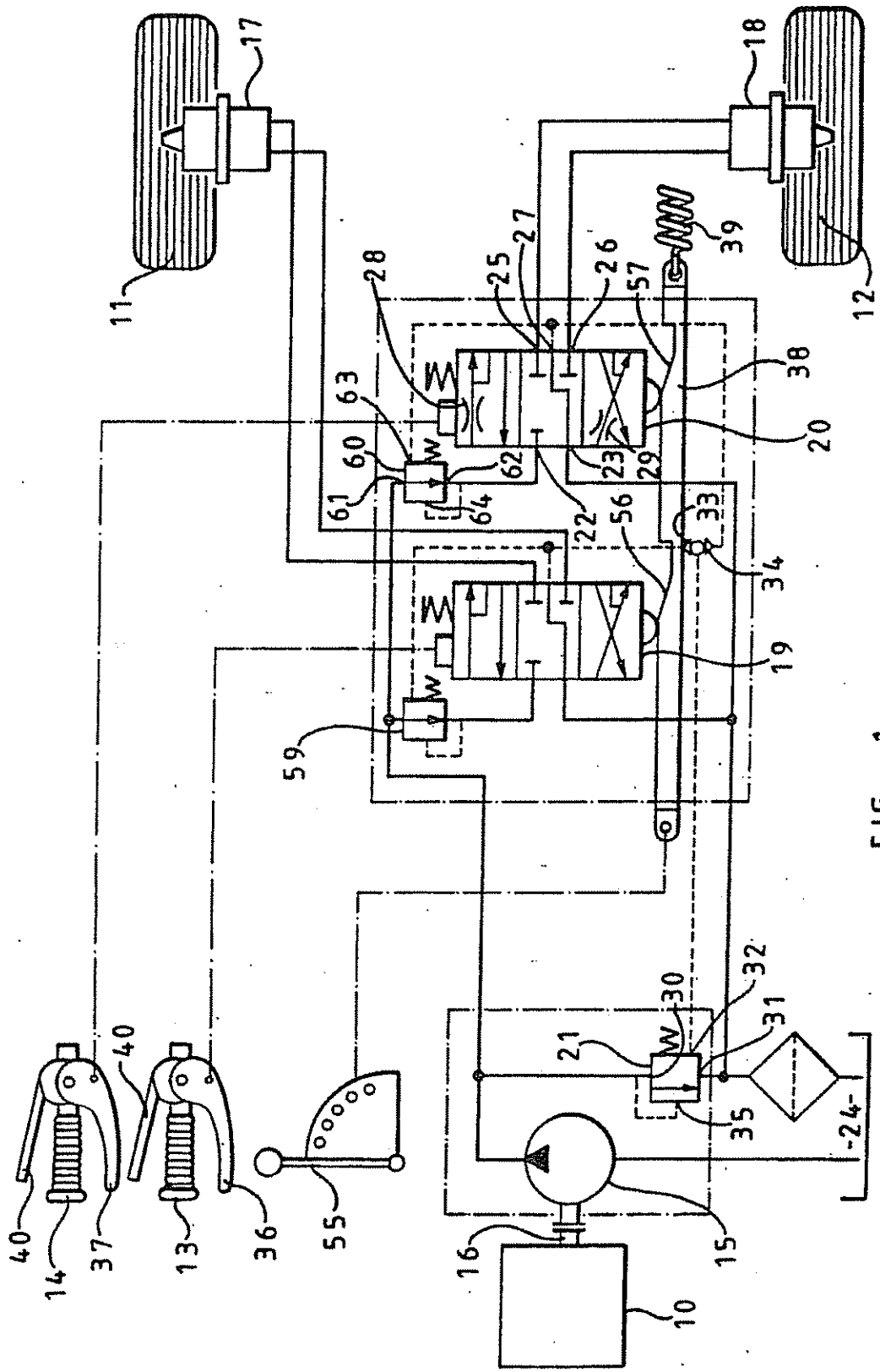

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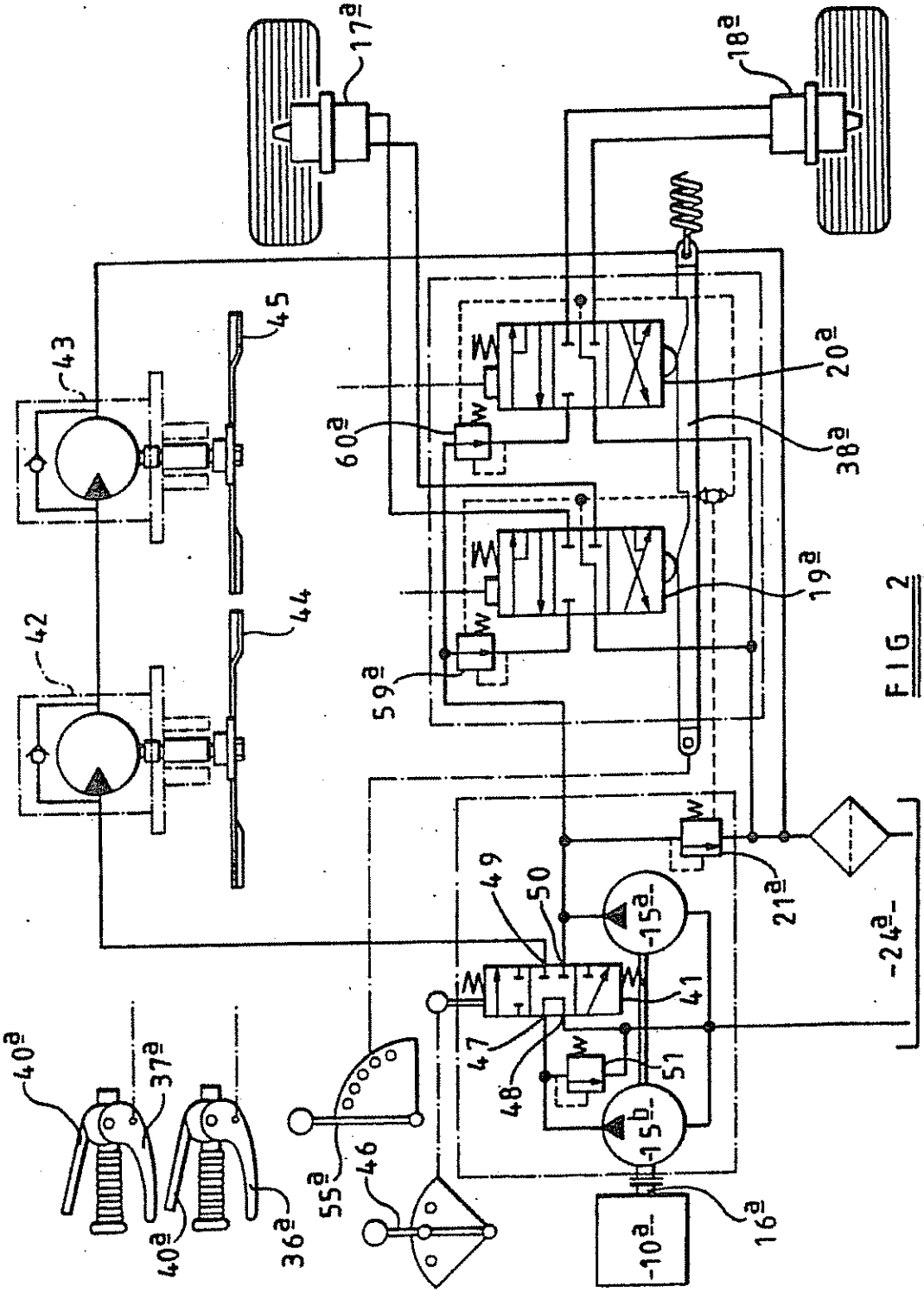
FIG 1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47
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51
15b
40a
37a
55a
46
36a
40a
10a
16a

FIG 2

HYDROSTATIC TRANSMISSIONS

RELATED APPLICATION

This is a continuation-in-part of Ser. No. 07/600,823 filed Oct. 22, 1990 pending.

INTRODUCTION

This invention relates to a hydrostatic transmission for a vehicle, such as a commercial walk-behind mower.

It is known to provide commercial walk-behind mowers with a hydrostatic transmission between the mower's engine and its driven wheels. The known transmissions make use of two variable displacement pumps to drive hydraulic motors connected, respectively, to two driven wheels of the mower. The mower is driven in a straight line when the fluid flow from the two pumps is equal and is steered by adjusting the pumps so that the fluid flow therefrom is different. These known hydrostatic transmissions are expensive because of the high cost of variable displacement hydraulic pumps. Also, it is usual to drive the mower blade by a belt drive directly from the engine. This is often extremely inconvenient because of the need to align engine and blade pulleys.

It is therefore an object of this invention to provide a hydrostatic transmission in an improved form.

SUMMARY OF THE INVENTION

According to one aspect of the present invention there is provided a hydrostatic transmission for a vehicle, comprising a fixed displacement hydraulic pump, first and second reversible hydraulic motors for driving first and second ground engageable wheels, respectively, of the vehicle, and first and second valve means for controlling hydraulic fluid flow from the fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle.

Preferably, the hydrostatic transmission further comprises a load sensing relief valve to unload excess flow from the pump.

Conveniently, each of the first and second valve is in the form of spool valve, which may have a pressure compensating valve connected to its inlet so that for a given spool position the spool valve will pass a given flow regardless of the pressure demand on it.

Conveniently, the first and second hydraulic motors are in the form of gerotor motors.

According to another aspect of the present invention, there is provided a vehicle having a prime mover, two driven ground engageable wheels and a hydrostatic transmission connecting the prime mover to the two wheels, the hydrostatic transmission comprising a fixed displacement hydraulic pump connected to the prime mover, first and second reversible hydraulic motors connected to the two wheels, respectively, and first and second valve means for controlling hydraulic fluid flow from the fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle.

According to yet another aspect of the present invention, there is provided a hydrostatic transmission for a vehicle, comprising first and second fixed displacement hydraulic pumps, first and second reversible hydraulic motors for driving first and second ground engageable wheels, respectively, of the vehicle, a fluid pressure operated device, first and second valve means for controlling hydraulic fluid flow from the first fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle, and third valve means movable between a first position in which in use hydraulic fluid from the second hydraulic pump is supplied to the fluid pressure operated device and a second position in which in use hydraulic fluid from the second hydraulic pump supplements hydraulic fluid supplied to the motors from the first hydraulic pump.

Preferably, the hydrostatic transmission further comprises a load sensing relief valve to unload excess flow from the first hydraulic pump, and also excess flow from the second hydraulic pump when the third valve means is in said second position.

Conveniently, the fluid pressure operated device comprises at least one further hydraulic motor which may, for example, be used to drive a mower blade or blades.

Advantageously, the first and second hydraulic pumps are arranged in tandem.

Conveniently, the first, second and third valve means are in the form of spool valves, and each of the first and second spool valves may have a pressure compensating valve connected to its inlet so that for a given spool position the spool valve will pass a given flow regardless of the pressure demand on it.

Conveniently, the first and second hydraulic motors are in the form of gerotor motors.

According to a still further aspect of the invention, there is provided a vehicle having a prime mover, two driven ground engageable wheels, a power driven device on the vehicle, and a hydrostatic transmission connecting the prime mover to the two wheels and the power driven device, the hydrostatic transmission comprising first and second fixed displacement hydraulic pumps connected to the prime mover, first and second reversible hydraulic motors connected to the two wheels, respectively, a fluid pressure operated device connected to the power driven device, first and second valve means for controlling hydraulic fluid from the first fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle, and third valve means movable between a first position in which hydraulic fluid from the second hydraulic pump is supplied to the fluid pressure operated device and a second position in which hydraulic fluid from the second hydraulic pump supplements hydraulic fluid supplied to the motors from the first hydraulic pump.

Preferably, the power operated device is a mower blade and the fluid pressure operated device is a further hydraulic motor for driving the mower blade.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an hydraulic circuit diagram of one embodiment of a hydrostatic transmission according to the present invention, and

FIG. 2 is an hydraulic circuit diagram of another embodiment of an hydrostatic transmission according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring firstly to FIG. 1 of the drawings, there is shown therein a hydrostatic transmission for a commercial walk-behind mower. The mower has an internal combustion engine 10, two driven ground engaging wheels 11 and 12, and hand grips 13 and 14 at the rear of the mower.

The hydrostatic transmission comprises a single fixed displacement hydraulic pump 15 connected to the driven shaft 16 of the engine 10, two hydraulic motors 17 and 18 connected to the two wheels 11 and 12, respectively, two flow control valves 19 and 20, and a load sensing relief valve 21.

The pump 15 is typically in the form of a rotary gear pump and the motors 17 and 18 are typically in the form of gerotor motors.

The valves 19 and 20 control fluid flow from the pump 15 to the two motors 17 and 18, respectively. These valves 19 and 20 are in the form of spool valves having associated pressure compensating valves 59 and 60, respectively, and are of identical construction. Therefore, only valve 20 and its associated pressure compensating valve 60 will be described in detail.

The valve 20 has an inlet port 22 connected to the supply line from the pump 15 via the pressure compensating valve 60, a return port 23 connected to an hydraulic fluid reservoir 24, two ports 25 and 26 connected to the motor 18 and a load sensing port 27. The spool of valve 20 is shown in a central position and when in this position the spool will block fluid flow both to port 25 and port 26. Therefore, there will be no fluid flow to the motor 18. If the spool is moved in one direction, inlet port 22 will be connected to port 25 via a variable orifice 28 which increases as the spool moves further from its central position, and port 26 will be connected to return port 23. The motor 18 will rotate to drive the wheel 12 in a forwards direction. If the spool is moved in the opposite direction from its central position, inlet port 22 will be connected to port 26 via a variable orifice 29 which increases as the spool moves further from its central position, and port 25 will be connected to return port 23. The motor 18 will rotate to drive the wheel 12 in a rearwards direction.

The load sensing relief valve 21 has an inlet port 30 connected to the supply line from the pump 15 and an outlet port 31 connected to the reservoir 24. The relief valve 21 also has a load sensing port 32 connected to the load sensing ports 27 of the valves 19 and 20 via non-return valves 33 and 34, respectively, and a further port 35 connected to the inlet port 30. The load sensing ports 27 communicate with the fluid pressure downstream of the variable orifices 28, 29 when the valves 19, 20 are in other than central positions, and the non-return valves 33, 34 communicate the higher of the pressures at the load sensing ports 27 of the valves 19 and 20 with the load sensing port 32 of the relief valve 21.

The valve 21 is fully open when the differential pressure between the ports 32 and 35 is at a maximum, i.e. when the pump 15 is supplying fluid and the valves 19 and 20 are in respective central positions to block fluid flow to the motors 17 and 18. As one or both valves 19 and 20 open, the pressure at the load sensing port 32 will increase as one or other variable orifice 28, 29 in the or each valve 19, 20 increases, and the valve 21 begins to close so that less fluid is returned to the reservoir 24. When both valves 19 and 20 are fully open, the differential pressure between the ports 32 and 35 of the valve 21 is substantially zero and the valve 21 closes so ensuring that the entire output of the pump 15 is delivered to the motors 17 and 18.

Valve 60 is a conventional pressure compensating valve. It has an inlet port 61 connected to the supply line from the pump 15, an outlet port 62 connected to the inlet port 22 of the spool valve 20, a load sensing port 63 connected to the load sensing port 27 of the spool valve 20, and a further port 64 connected to its outlet port 62.

The pressure compensating valves 59 and 60 are provided to prevent one or other of the motors 17 and 18 drawing all of the flow from the pump 15 in the event that, for example, one of the wheels 11, 12 begins to slip, and ensure that each motor 17, 18 can only draw the flow selected for it regardless of the torque on the motor. The pressure compensating valves 59 and 60 thus ensure that each spool valve 19, 20 will pass a given flow for a given spool position regardless of the pressure demand on it.

Control levers 36 and 37 are mounted on hand grips 13 and 14, respectively, for operating the valves 19 and 20. By manipulating the levers 36 and 37, it is possible to control the rotational speed and direction of rotation of each motor 17, 18 so as to regulate the ground speed of the mower and alter its direction of travel. Indeed, if desired one motor could be driven in a forwards direction and the other in reverse in order to cause the mower to make a tight turn.

A locking device and speed limiter 38 is provided to lock the valves 19 and 20 in respective central positions and cut off fluid flow to the motors 17 and 18. The locking device 38 is urged by a spring 39 to a locking position and is disengaged by a control lever 55. As shown, the locking device 38 also has two ramps 56 and 57 which co-operate with the spool valves 19 and 20, respectively, when the control lever 55 is in one of a number of available intermediate positions to act as speed limiters.

Each hand grip 13, 14 is provided with a dead man lever 40 connected to the engine 10. If both levers 40 are released by an operator, the engine 10 will cut out to prevent an accident

The load sensing relief valve 21 is mounted close to the pump 15 and the valves 19, 20, 59 and 60 are formed as a monobloc, i.e. in the same body.

In the embodiment described above, the mower blade or blades (not shown) are driven in conventional manner by a belt drive between the engine 10 and the blade(s).

However, FIG. 2 shows a hydrostatic transmission which drives mower blades as well as the ground engaging wheels of the mower.

The hydrostatic transmission shown in FIG. 2 comprises two fixed displacement hydraulic pumps 15*a* and 15*b*, typically gear pumps, connected in tandem to the driven shaft 16*a* of the engine 10*a*, two hydraulic motors 17*a* and 18*a* connected to driven wheels 11*a* and 12*a*, respectively, first and second flow control valves 19*a* and 20*a* having associated pressure compensating valves 59*a* and 60*a*, and a load sensing relief valve 21*a*.

Pump 15*a* supplies fluid to the motors 17*a* and 18*a* via the compensating valves 59*a* and 60*a* and the valves 19*a* and 20*a*, and valves 19*a* and 20*a* are operated by control levers 36*a* and 37*a* all in the manner described with reference to the embodiment of FIG. 1.

The transmission of FIG. 2 has a further or third valve 41 and two further hydraulic motors 42 and 43, which in this case are typically gear motors, for rotating two mower blades 44 and 45, respectively.

The valve 41 is a three position spool valve operated by a control lever 46. The valve 41 has an inlet port 47 connected to the pump 15*b*, a return port 48 connected to hydraulic fluid reservoir 24*a*, a port 49 connected to the motors 42 and 43, and a port 50 connected to the inlet ports of the two compensating valves 59*a* and 60*a*.

A pressure relief valve 51 is provided between the supply line from pump 15*b* and the fluid reservoir 24*a*.

When the spool of valve 41 is in a central position, inlet port 47 is connected directly to return port 48 and the pump 15*b* circulates fluid to and from the reservoir 24*a*. When the spool of valve 41 is moved in one direction (downwards from the position shown in FIG. 2), inlet port 47 is connected to port 49 and the pump 15*b* supplies fluid to the motors 42 and 43 to drive the mower blades 44 and 45, respectively. When the spool of valve 41 is moved in an opposite direction from its central position (upwards from the position shown in FIG. 2), inlet port 47 is connected to port 50 so that the pump 15*b* supplies fluid to the inlet ports 22*a* of the two valves 19*a* and 20*a* to supplement the fluid supplied by the pump 15*a*, and the port 49 is connected to the return port 48 to drain fluid from the motors 42 and 43 to the reservoir 24*a*.

Thus, the mower can be driven across the ground at a much higher speed when not performing a mowing operation.

In this embodiment, the load sensing relief valve 21*a* will unload excess flow from pump 15*a* in the manner described previously and also excess fluid from the pump 15*b* when this pump supplements the fluid supplied by the pump 15*a*.

The transmission shown in FIG. 2 also has a locking device and speed limiter 38*a* operated by a control lever 55*a*, and dead man levers 40*a*.

The valves 41 and 51 are mounted adjacent to the pumps 15*a* and 15*b* and the valves 19*a*, 20*a*, 59*a* and 60*a* are formed as a monobloc.

The two motors 42 and 43 could be replaced by a single motor driving the two mower blades 44 and 45 via a belt drive.

The three position spool valve 41 could be replaced by a two position spool valve which in one position circulates fluid to and from the pump 15*b* and in the other position connects the pump 15*b* to the motors 42 and 43. In this case, there is no provision for pump 15*b* to supplement the pump 15*a*.

The above embodiments are given by way of example only and various modifications will be apparent to persons skilled in the art without departing from the scope of the invention defined by the appended claims.

What is claimed is:

1. A hydrostatic transmission for a vehicle, comprising first and second fixed displacement hydraulic pumps, first and second reversible hydraulic motors for driving first and second ground engageable wheels, respectively, of the vehicle, a fluid pressure operated device, first and second value means for controlling hydraulic fluid flow from the first fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle, each of said first and second valve means having an inlet port and a pressure-compensated valve between said inlet port and said first fixed displacement hydraulic pump, third valve means movable between a first position in which in use hydraulic fluid from the second hydraulic pump is supplied to the fluid pressure operated device and a second position in which in use hydraulic fluid from the second hydraulic pump supplements hydraulic fluid supplied to the motors from the first hydraulic pump, and a load sensing relief valve for unloading excess flow from the first hydraulic pump and also excess fluid flow from the second hydraulic pump when the third valve means is in said second position.

2. A hydrostatic transmission as claimed in claim 1, wherein the third valve means is movable to a third position in which hydraulic fluid from the second hydraulic pump is returned to drain.

3. A hydrostatic transmission as claimed in claim 1, wherein the fluid pressure operated device comprises at least one further hydraulic motor.

4. A hydrostatic transmission as claimed in claim 1, wherein the first and second hydraulic pumps are arranged in tandem.

5. A hydrostatic transmission as claimed in claim 1, wherein the first, second and third valve means are in the form of spool valves.

6. A vehicle having a prime mover, two driven ground engageable wheels, a power driven device on the vehicle, and a hydrostatic transmission connecting the prime mover to the two wheels and the power driven device, the hydrostatic transmission comprising first and second fixed displacement hydraulic pumps connected to the prime mover, first and second reversible hydraulic motors connected to the two wheels, respectively, a fluid pressure operated device connected to the power driven device to drive the power driven device, first and second valve means for controlling hydraulic fluid from the first fixed displacement hydraulic pump to the first and second hydraulic motors, respectively, whereby in use the two motors will be driven at the same rotational speed when the fluid flow to the two motors is equal to drive the vehicle along a straight line path and will be driven at different rotational speeds when the fluid flow to the two motors is different to steer the vehicle, each of said first and second valve means having an inlet port and a pressure-compensated valve between said inlet port and said first fixed displacement hydraulic pump, third valve means movable between a first position in which in use hydraulic fluid from the second hydraulic pump is supplied to the fluid pressure operated device and a second position in which in use hydraulic fluid from the second hydraulic pump supplements hydraulic fluid supplied to

the motors from the first hydraulic pump, and a load sensing relief valve for unloading excess flow from the first hydraulic pump and also excess fluid flow from the second hydraulic pump when the third valve means is in said second position.

7. A vehicle as claimed in claim 6, wherein the power operated device is a mower blade and the fluid pressure operated device is a further hydraulic motor for driving the mower blade.

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US005280695A

United States Patent [19]

Nunes, Jr. et al.

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[45] Date of Patent: Jan. 25, 1994

[54] WIDE AREA LAWNMOWER

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[73] Assignee: Nunes Manufacturing, Inc., Patterson, Calif.

[21] Appl. No.: 832,858

[22] Filed: Feb. 7, 1992

[51] Int. Cl.[5] A01D 75/30

[52] U.S. Cl. 56/6; 56/13.5; 56/15.2; 56/DIG. 9; 56/DIG. 14

[58] Field of Search ..... 56/6, 13.5, 13.7, 15.2, 56/15.8, 16.9, DIG. 9, DIG. 14

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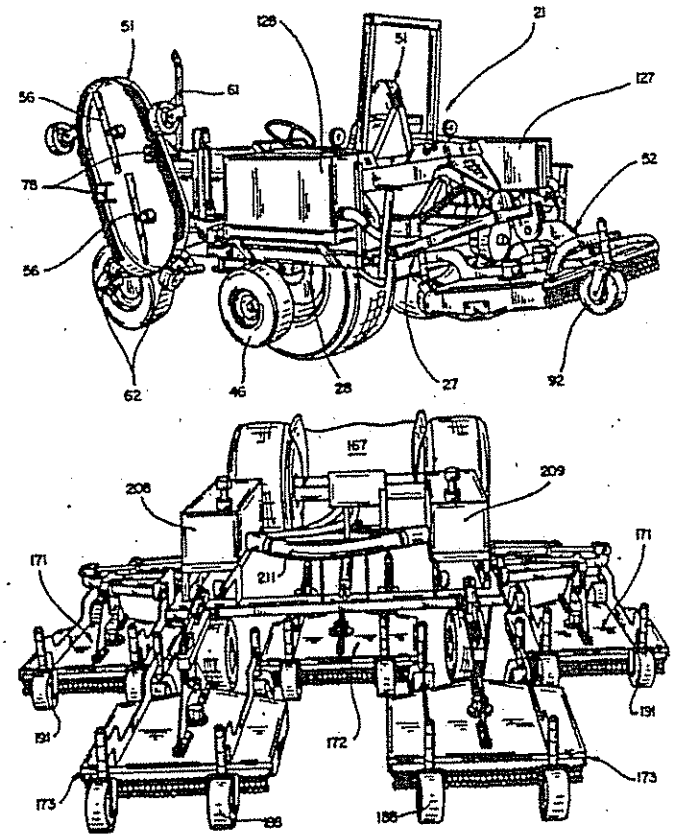
Attorney, Agent, or Firm—Flehr, Hohbach, Test, Albritton & Herbert

[57] ABSTRACT

Wide area mower which can be attached to and detached from a tractor in a relatively short time. In one disclosed embodiment, the mower has a main frame which is detachably connected to the rear mount of a tractor, swing frames pivotally connected to the main frame for movement into and out of engagement with the side mounts of the tractor, means detachably locking the swing frames in engagement with the side mounts, and mowing heads mounted on the frames to the sides and rear of the tractor. In another disclosed embodiment, the mower includes a frame adapted for connection to a towing vehicle, a pair of side decks positioned on opposite sides of the frame, a center deck positioned between the side decks, a pair of rear decks positioned to the rear of and between the side decks and the center deck. Ground engaging wheels at the front and rear of each deck support the decks, with the wheels at the rear of the side decks and the center deck being aligned with the wheels at the front of the rear decks, and means pivotally mounting the decks to the frame so that the decks can follow the contour of the ground.

23 Claims, 20 Drawing Sheets



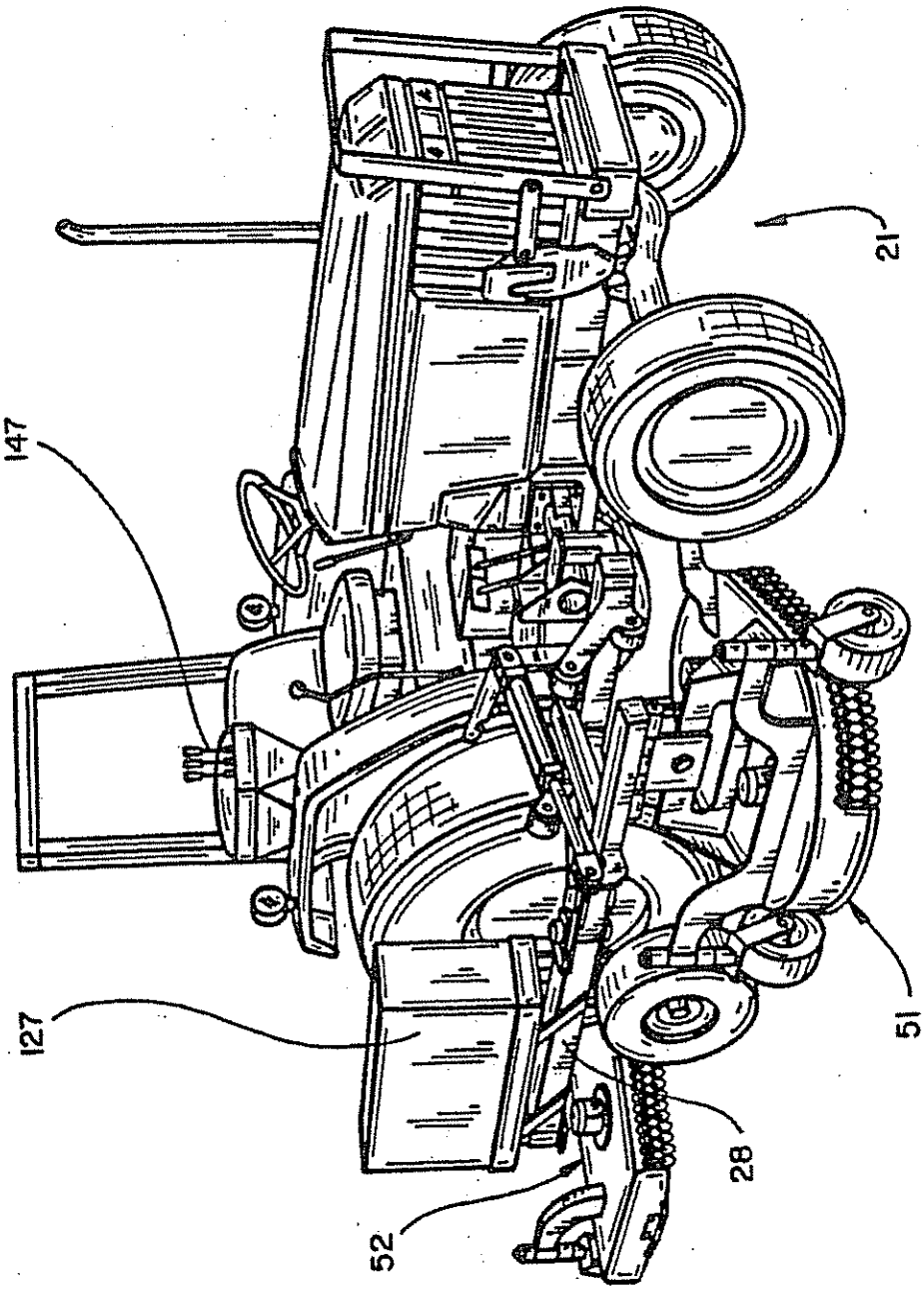


FIG_1

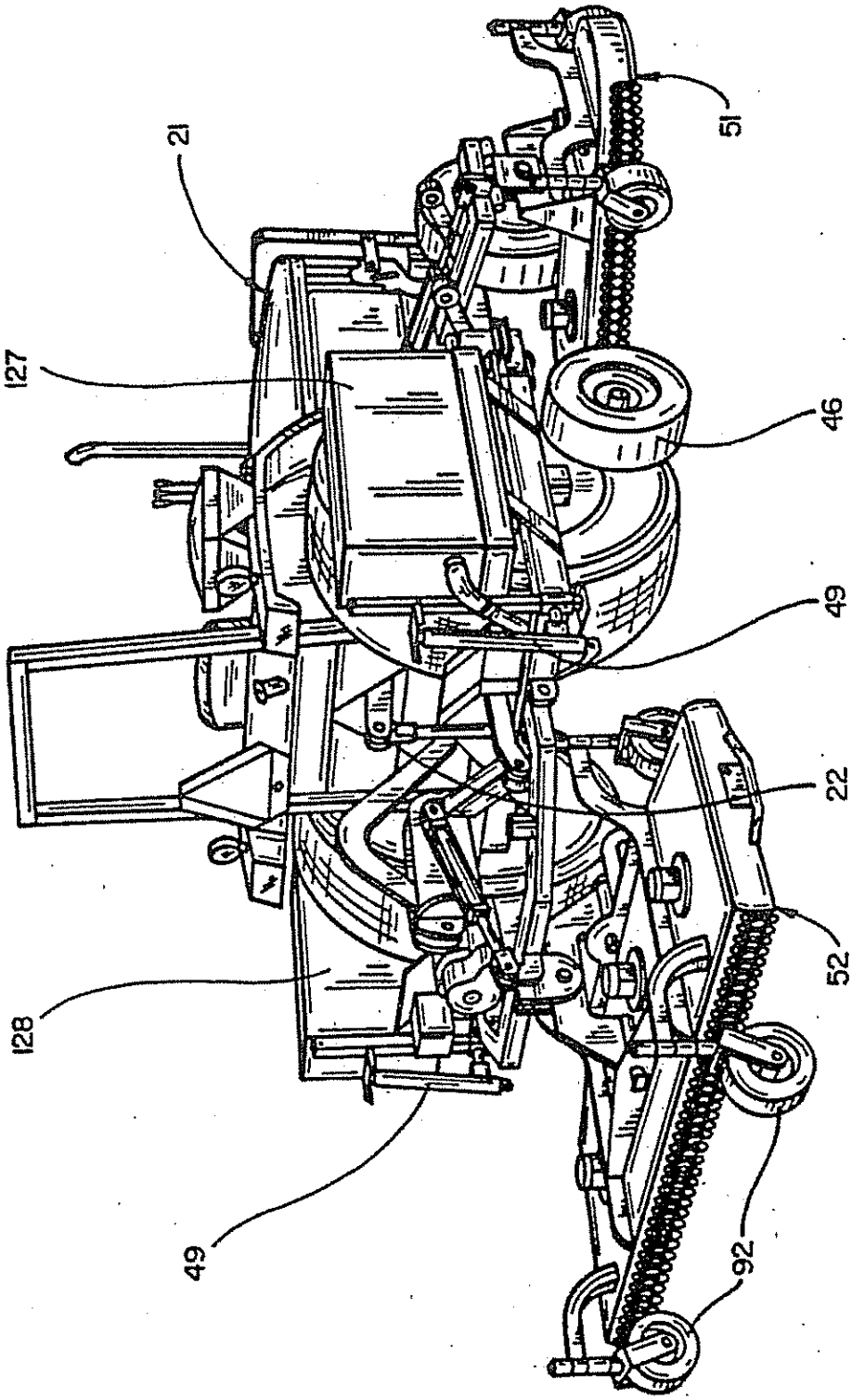


FIG_2

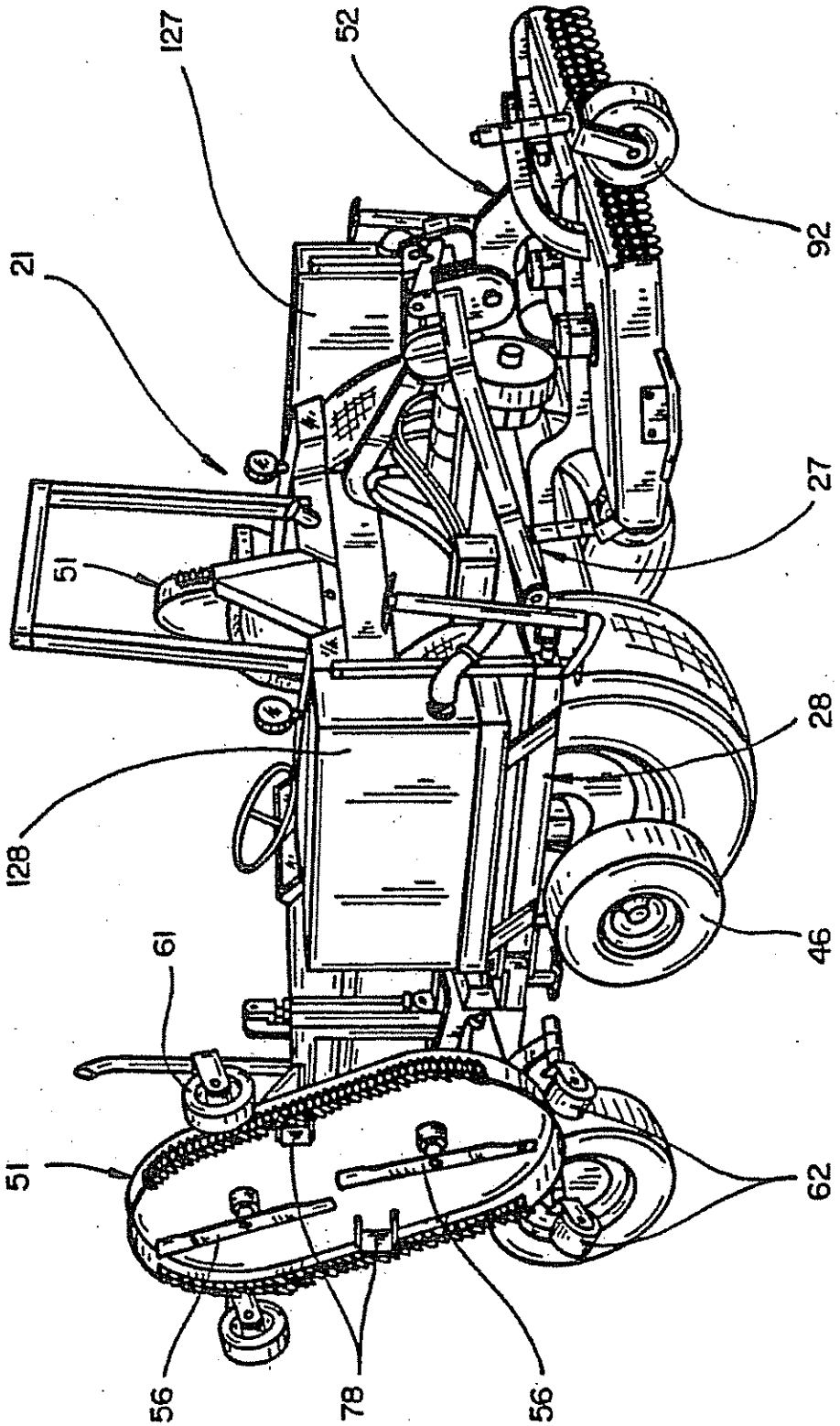


FIG_3

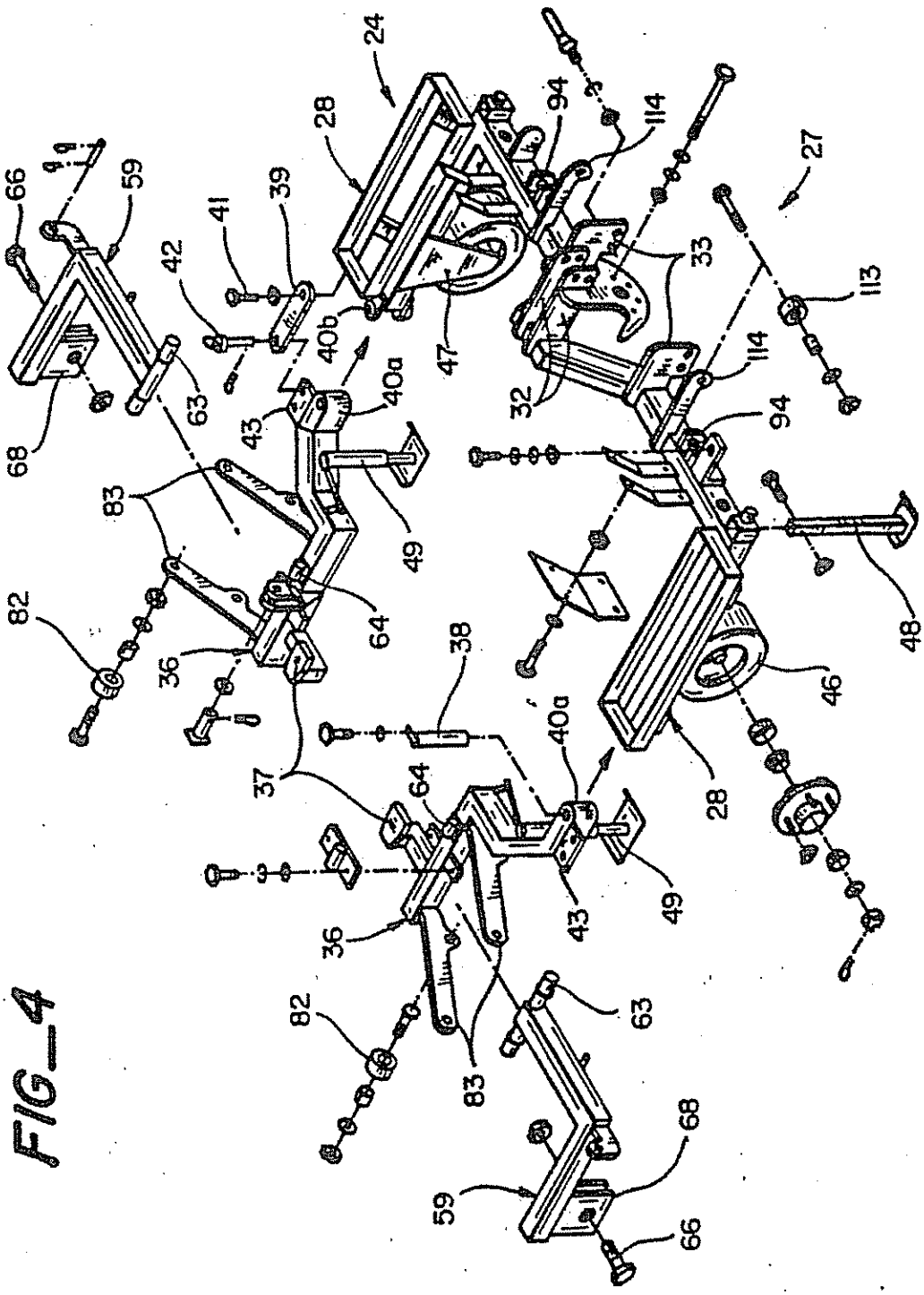

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FIG_4